REMARKS

The Office Action dated January 29, 2003 has been reviewed carefully and the application has been amended in a sincere effort to place the claims in condition for allowance.

Election/Restrictions

Applicant acknowledges the Restriction Requirement being made final by the Examiner, and Applicant is separately petitioning the Commissioner to reconsider this requirement.

Objection to the Specification

Applicant acknowledges the Examiner's indication about the trademarks NAFION® and TEFLON® and Applicant has amended the Specification and claims in an effort to ensure that those trademarks have been capitalized and noted as registered trademarks throughout.

Claim Rejections - 35 U.S.C. Section 112

Claim 24 was rejected on the grounds that the limitation "said electricity generating reactions" did not have proper antecedent basis. The word "said" has been deleted from the claim so that the phrase reads, "electricity generating reactions".

The term "generally parallel" in claims 24, 41, 44 and 54 was indicated as indefinite. However, Fig. 2A (item 22), Fig. 5 (items 522 and 524 on the cathode side) and Fig. 6, Fig. 7 and Fig. 8 each show the metallic diffusion layers on both the anode and the cathode side as being parallel to the protonically conductive membrane. Thus, this term is not indefinite since the Applicant's drawings, as identified in the Specification, clearly indicate this geometry.

The Examiner has also objected to the term "generally" as being indefinite. The word "generally" however, is well-accepted in patent claim language. For example, the term "generally parallel" was discussed by the United States Court of Appeals for the Federal Circuit in Advanced Cardiovascular Systems, Inc. ("ACS") v. Scimed Life Systems, Inc., 59 U.S.P.Q. 2d (BNA) 1801 (Fed.Cir.2001). The ACS decision related to the issue whether the term "generally parallel" that existed in some claims in the patent in suit, should be read into a claim that does not itself include that wording. But, in making a decision that such a construction was not warranted the court did not indicate that there was any indefiniteness to the term, and accepted the usage of the term "generally parallel."

In this instance, Applicant is claiming "generally parallel" elements and the drawings also show a parallel orientation. Thus, those of ordinary skill in the art are being reasonably apprised of the scope of the invention as claimed in claims 24, 41, 44 and 54.

The term "substantially" was objected to as used in claims 28 and 49. The Examiner has indicated that the term is a relative term that renders the claims indefinite. The term "substantially" is widely used in patent claim language and claims that include the term have been construed by the United States Court of Appeals for the Federal Circuit and those claims have not been rendered invalid for indefiniteness. Specifically, in Exxon Research and Engineering Co. v. United States, 60 U.S.P.Q.2d (BNA) 1272 (Fed.Cir.2001), (followed recently by Amgen, Inc. v. Hoechst Marion Roussel, Inc. 314 F.3d 1313, 65 U.S.P.Q.2d (BNA) 1385 (Fed.Cir.2003)), the Court of Appeals for the Federal Circuit upheld claims that included the phrases "to increase substantially" and "substantial absence of slug flow". The Federal Circuit held that mathematical precision is not required - only a reasonable degree of particularity and definiteness. Exxon, 60 U.S.P.Q. 2d at 1281. (Citing, Modine Mfg. V. Int'l Trade Commission, 75 F.3d 1545 (Fed. Cir. 1996). The claim limitation should be "sufficiently clear that a person of skill in the art would understand the scope of the claim...." Exxon, 60 U.S.P.Q. 2d at 1281.

In the present case, the claim limitation is the term "does not substantially react with methanol, or other reactants and by products of the electricity generating reac-

tions." This term relates to the materials that comprise the metallic diffusion layer. It is explained in the Specification on page 12, beginning at line 14 that "Preferably, the metallic anodic diffusion layer 22 is fabricated from stainless steel, titanium or other metal alloy that will not interfere with the reactions that generate electricity." Thus, one skilled in the art is given a reasonable degree of particularity and definiteness in the Specification about the claim limitation that makes it sufficiently clear that the material selected for the metallic diffusion layer should not substantially react with the substances in the fuel cell. For example, those skilled in the art would recognize that the metallic diffusion layer material should not act to adversely affect the electricity generating reactions or otherwise cause changes in the fuel cell that could affect fuel cell operations over the life of the fuel cell. For example, the material should not cause a chemical change in the fuel composition, or an appreciable chemical change in the other components in the fuel cell; and the material should not act to dissolve or corrode the components or cause contamination due to any such dissolution or corrosion, any or all of which could lead to degradation or minimization of performance of the fuel cell. These risks are within the understanding of those skilled in the art when reading the term "does not substantially react with methanol, or other reactants and by products of the electricity generating reactions, " and thus the term is not indefinite.

The term "loose", which is objected to as used in claim 29, 30 and 50 has been deleted.

The term "suitable" in claim 48 has been deleted.

Claim Rejections - 35 U.S.C. Section 102

Claims 24-30, 33, 37, 38, 41-51, 54-62 were rejected under 35 U.S.C. Section 102(e) as being anticipated by Cisar et al., United States Patent No. 6,410,180.

Briefly, Applicant's invention as claimed in independent claim 24, and the claims dependent therefrom, is a direct oxidation fuel cell system that, in one embodiment, includes an anodic metallic diffusion layer that limits the mass transport of the fuel substance to the membrane electrolyte. For example, on Page 12, beginning at line 16, the Specification states, "the metallic anode diffusion layer 22 distributes the fuel mixture to the membrane electrode assembly in an even controlled fashion and prevents the fuel from saturating the PCM 7." Similarly, on the cathode side, a metallic cathode diffusion layer can be used to limits oxygen travelling to the cathode side of the membrane and to resist water from escaping out of the cathode side which could result in drying out of the MEA. The diffusion layer on the anode side, for example, has pores, which are of a size such that they are small enough to allow diffusive flow of the fuel substance to the membrane electrolyte. In other words, the pore size is selected to limits the mass transport of this material such that active flow of materials does not occur but instead, the metallic diffusion layer allows diffusion to be the dominant process in the transport of fuel from the anode chamber to the anodic metallic diffusion layer. Pores of different sizes can be selected in that larger pores allow liquid reactants and byproducts to and from the PCM, while smaller pores allow for gas transport but not for liquid transport. Furthermore, these pores can, in accordance with the invention, be treated with a hydrophobic sub-

stance to repel aqueous solutions and to allow gas to travel through or to resist water from plugging or saturating smaller pores. Hydrophilic treatment can also be effected. A pattern can be established on the metallic diffusion layer, with some areas being hydrophobic and other areas being hydrophilic.

As stated on Page 14 of the application, "Such pore distributions as illustrated in Figure 3C are very useful for facilitating the anode and cathode reactions by creating discrete and continuous mass transport paths through the metallic component for each of the liquid reactants and byproducts, and the gaseous reactants and byproducts." Another advantage of the invention is that the anodic metallic diffusion layers and cathodic metallic diffusion layers are used <u>instead of</u> the traditional carbon paper or carbon cloth. The advantages of this are set forth at Page 16 of the Specification, beginning at line 8:

> Nor does the invention become saturated over time, as is the case with conventionally employed carbon paper and carbon cloth diffusion layers. Thus, the inventive metallic diffusion layers allow for a more robust fuel cell. Moreover, the carbon paper and carbon cloth presently employed also tend to shrink over time and to varying degrees, depending on the particular characteristics of each piece of material. This often makes it difficult to precisely cut or fabricate a diffusion layer with predictable characteristics. In contrast, the expansion contraction coefficient of metallic compounds are generally well known, making it easier to fabricate properly sized diffusion layers such as the diffusion layers 22 and 24 of Fig. 1. Commercial volume manufacturing and handling techniques for metal are generally better established than methods for working with carbon paper, and are better suited for working with robust materials (such as metals) than brittle or fragile materials (such as carbon paper or carbon impregnated cloth). Thus, forming diffusion layers in accordance with the present invention in commercial quantities will be easier and more consistent and predictable, and will result in more consistent production of high quality diffusion layers.

In contrast to Applicant's invention, the Cisar reference relates to a fuel cell that includes a metal grid 82 to enhance electrical conductivity that is embedded within a gas

diffusion electrode. For example, in the configuration of Fig. 6A, a metal grid 82 is embedded adjacent to the membrane 54. Cisar states, "The advantage of this arrangement is good electrical contact with the electrocatalyst for efficient current collection and the least interference with gas diffusion within the electrode." (Page 9, lines 44-46).

Simply, Cisar's metal grid is <u>not</u> a diffusion layer and it does not limit mass transport of reactants and products with the fuel cell. Cisar's metal grid is a current collector that is intended and is specifically designed such that it does not affect or limit or encourage the introduction and removal of reactants and products to the MEA. In fact, the openings of Cisar's metal grid (such as the openings illustrated in Fig. 11) are too large to provide control over mass transport of reactants and products. In Cisar, the gas diffusion layer 58 performs the mass transport control. This is true even in Figs. 30A and 30B. Even though a separate current collector may not be needed in the embodiment of Fig. 30A, Cisar still requires the gas diffusion layer component 58 in addition to the metallized grid 82 (Figs. 6A and 30A). The metal grid is not a diffusion layer, and simply cannot limits mass transport of reactants and byproducts. Instead, Cisar's metal grids are used to conduct current from one cell to the adjacent cell as indicated by the Examiner.

Thus, Cisar does not anticipate independent claim 24, as amended, because it does not teach a metallic diffusion layer that has openings that are sized to limit the mass transport of reactants and products as claimed by Applicant.

Claim Rejections - 35 U.S.C. Section 103

Claims 31, 32, 34-36, 39, 40, 52 and 53 were rejected under 35 U.S.C. Section 103(a) as being unpatentable over Cisar, as applied earlier above, and in further view of Yu et al., United States Patent No. 6,399,202.

Yu discloses a gas diffusion electrode for use in a fuel cell system. Yu teaches, as the substance for the gas diffusion layer, a modified carbon product such that the modified carbon product that has an hydrophilic or hydrophobic organic group attached chemically to the carbon. The modified carbon product can be implemented with a controlled degree of hydrophobic or hydrophilic characteristics by using carbon particles modified with various functional groups. Yu says nothing about metallic diffusion layers, or about mass transport control though a porous metallic diffusion layer. Thus, Yu alone does not render Applicant's invention obvious.

In addition, as noted herein, Cisar does not teach Applicant's metallic diffusion layers, which include pores sized to limit the mass transport of reactants and products throughout the fuel cell. In fact, Cisar does not suggest a metallic diffusion layer at all. Furthermore, Cisar teaches away from Applicant's invention by requiring a traditional diffusion layer in addition to the metal grid. Accordingly, Cisar alone does not render Applicant's invention obvious.

Furthermore, simply adding Yu's teaching of hydrophobicity or hydrophilicity to Cisar's metal grid does not suggest, disclose or teach Applicant's invention because there is still no mass transport control as effected by Applicant's invention. In other words, the Examiner has suggested that it would be obvious to one of ordinary skill at the art to treat

the gas diffusion layer of Cisar with PTFE and/or and NAFION because Yu suggested the importance of hydrophobic/hydrophilic properties. However, simply treating Cisar's metal mesh or his entire gas diffusion layer with hydrophobic or hydrophilic properties still does not result in, nor does it even suggest Applicant's invention because it does not suggest controlling mass transport with a metallic diffusion layer.

Moreover, the pores being of different sizes is not simply inherent, as suggested by the Examiner, but is a characteristic of Applicant's invention that is well described in the Specification and claims. The pores may, but need not be, distributed randomly on the metallic diffusion layer. The pores are distributed with particularity depending upon whether they are intended to control liquids versus gases, and whether the pores are disposed on the anode metallic diffusion layer, the cathode metallic diffusion layer or depending on the other components contained within the fuel cell. There is no suggestion in either Yu or Cisar that pores should be of a size to suggest that diffusion is the controlling process or to otherwise control the mass transport of the reactants and byproducts. Cisar has a metal mesh in order to control electrical conductivity. Yu is a gas diffusion layer that uses a carbon group that has a chemically bound organic group to add hydrophobicity or hydrophilicity in an overall carbon-based diffusion material. It is not inherent in nor is it suggested in either reference that mass transport is controlled by selecting pore size and/or treating particular pores with hydrophobic or hydrophilic substances in a metallic diffusion layer as claimed by Applicant.

Claim 24 has been amended, and it is the sole independent claim being considered in this particular Office Action. Applicant respectfully submits that based, upon the fore-

going arguments, claim 24 as amended is patentable over the cited references. All of the claims have been amended either directly or through dependency, and all of the rejections and objections made by the Examiner have been addressed herein. It is thus respectfully submitted that the application is now in condition for allowance.

Please do not hesitate to contact the undersigned in order to advance the prosecution of this application in any respect.

Please charge any additional fee occasioned by this paper to our Deposit Account No. 03-1237.

Respectfully submitted,

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